Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	IB Docket No. 15-256
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664
	)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	)	WT Docket No. 10-112
	)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	)	IB Docket No. 97-95

REPLY COMMENTS OF NOKIA

Nokia respectfully submits Reply Comments in response to the Commission's Further Notice of Proposed Rulemaking ("FNPRM")[1] seeking comment on specific spectrum bands above 24 GHz to promote the next generation of wireless.

[1] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket Nos. 14-177 et al., Further Notice of Proposed Rulemaking (rel. July 14, 2016) ("*FNPRM*").

I. INTRODUCTION AND SUMMARY

Nokia continues to support each of the individual bands identified for terrestrial mobile in the FNPRM, in general agreement with the Commission. Nokia also cautions the Commission to not over-complicate licensing frameworks and deployment metrics for these bands. For example, Nokia continues to be skeptical of creating special in-building rights and also opposes "use or share" proposals, both of which the Commission declined to adopt in the NPRM phase of this proceeding.[2] Various sharing frameworks should be considered before settling on a sharing framework in any particular band.

Nokia has submitted to the Commission technical considerations for Spectrum Access System (SAS) and other non-SAS sharing frameworks for particular bands, and augmented the record, as requested by the Commission, on terrestrial 5G-Fixed Satellite Service (FSS) sharing issues in the 24 GHz, 28 GHz, and similar bands. We urge the Commission to consider the technical studies we provided regarding 5G-Fixed Service (FS) and 5G-FSS sharing, in the 70/80 GHz Band and the 28 GHz Band (but applicable to other bands to be shared by 5G and FS and 5G and FSS respectively).[3]

In these Reply Comments, we continue to augment the technical record, including submitting a study of the coexistence of fixed service with 5G user equipment (UEs) and a solution which proves to be an effective mitigation technique. We also voice concern regarding Boeing's recent claims that satellite systems should be permitted to transmit in the 37/39 GHz band at higher power levels. The Boeing analysis lacks sufficient detail on the record to evaluate whether their conclusions are valid.

[2] *Id.* ¶¶ 111, 474.

[3] *See* Comments of Nokia, GN Docket No. 14-177 et al., filed Sept. 30, 2016 ("Comments of Nokia"); Letter from Jeffrey A. Marks to Marlene Dortch, GN Docket No. 14-177 et al., dated October 20, 2016.

II. THE COMMISSION SHOULD STUDY VARIOUS TOOLS BEFORE ADOPTING A SHARING FRAMEWORK IN THE mmWAVE BANDS

Nokia continues to strongly recommend that the Commission take into account the characteristics of the mmWave bands and other factors when developing the sharing framework in those bands. In our Comments,[4] Nokia provided a technical review of a SAS as applied to mmWave spectrum and other sharing technologies that the Commission should weigh as it determines how best to implement various shared bands in this proceeding.

In particular, Nokia presented a solution to mitigate potential interference from 5G Access Points (APs) into Fixed Links in bands like 70 GHz and 80 GHz that would have the mobile base station calculate or learn the offending beams and then defer transmission on only a subset of beams effectively notching small slices of the coverage area in azimuth and elevation. The end result would leave the consumer better served as ubiquitous street level coverage could still be achieved by providing signal from an adjacent mobile base station serving the user from a different angle.

To complement this solution, Nokia also proposes in these Reply Comments a solution to mitigate any potential interference from 5G UEs into Fixed Links. The solution consists of two steps: (i) identifying UEs that cause high interference level into Fixed link Rx's and (ii) suppressing that interference. In step (i), a UE embeds a special cell-specific pseudo-random signal (a PN sequence) into the UE uplink Demodulation Reference Signal (DMRS) pilot sequences that would uniquely identify the serving cell of the transmitting UEs. Based on the time-slot (or subframe) of the interfering transmission and the identity of the serving cell, an interfering UE can be uniquely identified in the 5G access system. In step (ii), the interfering

[4] *See* Comments of Nokia, Appendix 1.

UEs are handed over to alternative APs toward which the UEs can point the uplink beams with interference powers that are below the interference threshold of the Fixed link. When no alternative AP exists within an interfering UE's range, the UE shuts down its uplink transmission for the specific time slot.

Appendix 1 to these Reply Comments provides a study of the coexistence of fixed service with 5G UEs and the solution proposed above which proves to be an effective mitigation technique.

III. NOKIA DISAGREES WITH BOEING THAT THE COMMISSION SHOULD AUTHORIZE SATELLITE SYSTEMS TO TRANSMIT IN THE 37/39 GHZ BAND AT THE HIGHER ITU POWER LEVELS

In its Comments to the FNPRM, [5] Boeing presented an analysis that led to its claim that demonstrated that satellite downlink transmissions at the higher ITU PFD level would have no material adverse impact on terrestrial operations in the band. Nokia is concerned, however, with the lack of clarity on what some of the key assumptions were in the analysis. For instance, the following are several examples of information interested parties would need to be able to analyze the study and independently evaluate Boeing's claims:

1. What is the altitude of the satellite orbit? Are GSO or NGSO orbits assumed in the interference analysis?
2. What is the assumed tilt (relative to horizon in elevation) from 5G AP/UE into the satellite transmitter? For NGSO orbits, the tilts are time-varying. What is the minimum tilt value for NGSO orbits?

[5] Comments of the Boeing Company, GN Docket No. 14-177 et al., at Section V, filed Sept. 30, 2016.

3. What is the satellite antenna gain toward 5G APs and UEs? Does the analysis assume that the 5G UEs and APs fall in the main beam of the satellite antenna?
4. What is the assumed satellite transmit power density per Hz?
5. What is the bandwidth of satellite transmissions? Does the analysis assume co-channel interference with the 5G systems?
6. What kind of propagation model is assumed for this study?
7. In the aggregate satellite interference analysis, how many satellites are assumed and what are their characteristics? Is worst-case or average interference scenario is analyzed?
8. How Boeing derived certain key 5G parameters such as antenna gains towards the satellite transmitter?

Without a clear understanding of the assumptions used in the study, Nokia is unable to assess the validity of Boeing's study and its claim that satellite downlink transmissions at the higher ITU PFD level would have no material adverse impact on terrestrial operations in the band. Nokia therefore urges that Boeing's conclusions not be accepted on their face, and that a more thorough analysis of their study is needed than would be possible based on the information currently on the record.

IV. CONCLUSION

Nokia requests that the Commission adopt service rules for each of the bands proposed in the FNPRM consistent with Nokia's submissions in this proceeding and consider, on

a band-by-band basis, the sharing frameworks that would best facilitate the success of each band. Further, Nokia continues to urge the Commission to also investigate mid-band (6 GHz to 24 GHz) and low-band (below 6 GHz, such as 3700-4200 MHz) spectrum as critical pieces to the future of wireless networks.

Respectfully submitted,

Nokia

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APPENDIX

Appendix 1
Coexistence of 5G User Equipment and Fixed Links in the 71-76 GHz & 81-86 GHz Bands